

## Rapid Communications

### First record of *Klasea quinquefolia* (M.Bieb. ex Willd.) Greuter & Wagenitz (Asteraceae) in Italy

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### Abstract

*Klasea quinquefolia* (M.Bieb. ex Willd.) Greuter & Wagenitz is a perennial and rhizomatous herb native to the Russian Caucasus, Armenia, Azerbaijan, Georgia, Iran, and Asian Turkey. The natural habitats of the species are deciduous forests or open areas in hill/mountain areas. Outside the native range, the species is mainly known for its ethnobotanical and pharmaceutical uses but in recent years, it has been also recorded as an alien species in Austria. In this work, we reported the first occurrence of *K. quinquefolia* in Italy. The species was recorded in August 2023 in the Monza Park (Lombardy, N-Italy) in a mesophilous woodland dominated by *Carpinus betulus*. The new population was subdivided in 10 subpopulations distributed in habitat patches with surface areas ranging from 0.085 to 95,008 m<sup>2</sup>. The total population accounted almost 500 individuals with a flowering population size of about 350 individuals. Likely, the establishment of *K. quinquefolia* is linked to the presence of internationally frequented facilities that might have favoured its unintentional arrival (e.g. the Monza Racetrack) or to historical reasons of past introductions to Royal Gardens of the Monza Palace. Presently, it should be treated as a naturalized alien species in Italy even if its further spreading could be favoured by the species' habitat preference and climate change.

**Key words:** invasive alien plants, early detection, eradication, neobiota, watchlist

### Introduction

*Klasea* Cass. is an Old World genus of perennial herbs that likely diversified in mountain regions of central Asia. It is distributed in the Iberian Peninsula, northern Africa, southern and eastern Europe, western and central Asia, Himalaya, eastern Russia and China (Martins 2006). It was dedicated to the memory of the Swedish student Laurentius M. Klase, one of Linnaeus' disciples (López-Jiménez 2007). *Klasea* was previously considered a section of *Serratula* L. as *Serratula* sect. *Klasea* (Cass.) DC.; recently, it has been recognized at the generic rank based on nuclear ribosomal DNA, and divided into 10 sections (Martins 2006). Nowadays, the genus *Klasea* includes 56



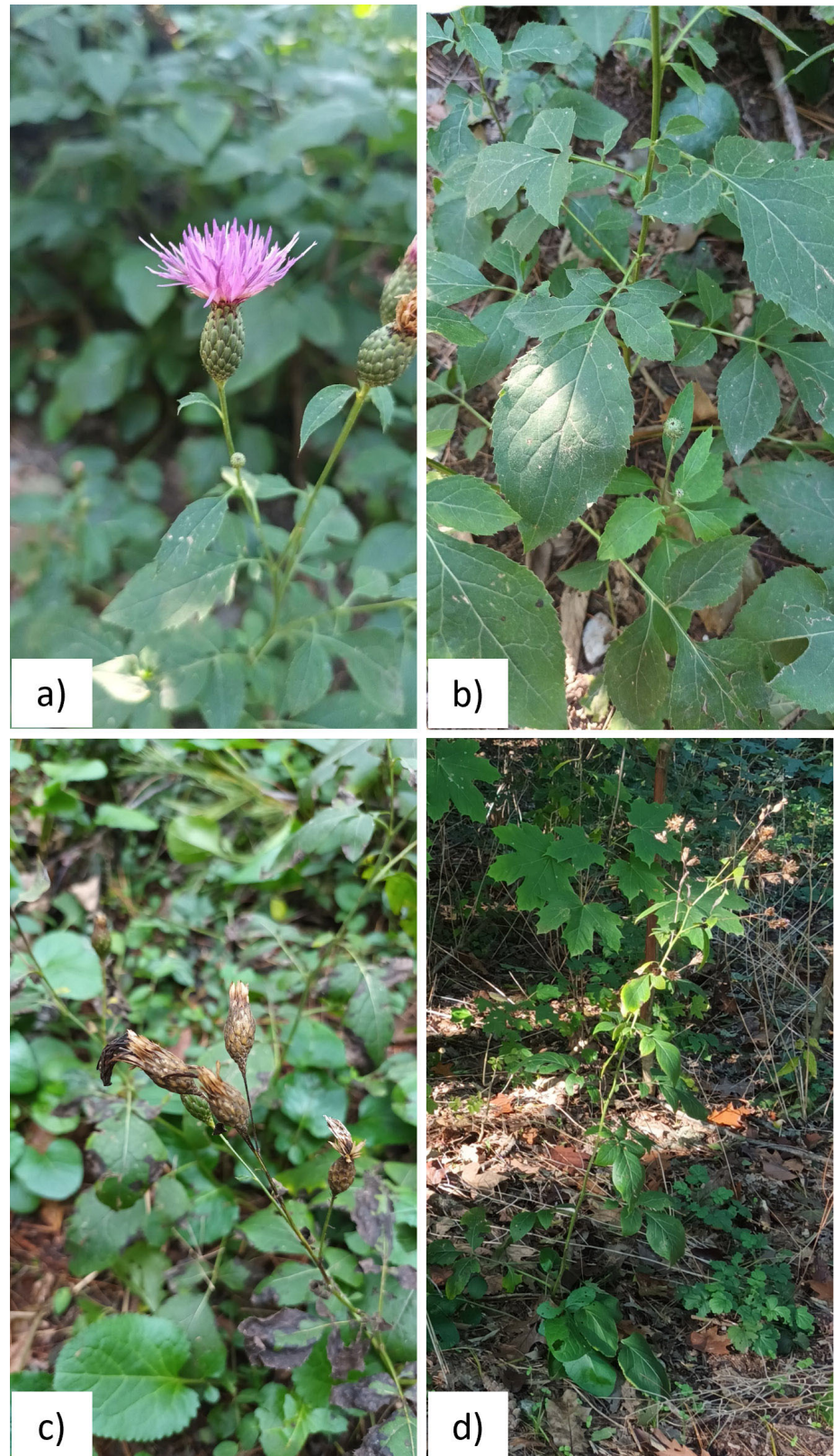
**Figure 1.** Protologue of *Serratula quinquefolia* M.Bieb. ex Willd., basionym of *Serratula quinquefolia* (M.Bieb. ex Willd.) Greuter & Wagenitz, published in *Species Plantarum* (Willdenow, 1803).

species and one hybrid (POWO 2023; <https://powo.science.kew.org>) and, to the best of our knowledge, none is reported as invasive alien.

Among the other species, *Klasea quinquefolia* (M.Bieb. ex Willd.) Greuter & Wagenitz ( $\equiv$  *Serratula quinquefolia* M.Bieb. ex Willd.) was first named by Friedrich August Marshall von Bieberstein and described by Carl Ludwig von Willdenow in “*Species Plantarum*” in 1803 (Willdenow 1803) (Figure 1). It is a branched perennial and rhizomatous herb, glabrous or scarcely pubescent, averaging between 50 and 120 cm in height (up to 2 m). Leaves are compounds, unpaired-pinnate with 3 to 5 lobes, ovate-oblong or oblong-lanceolate in shape (Figure 2). Basal leaves are petiolate, ovate, or oblong, and elongated towards the base. The few cauline leaves are elliptic to sub-lanceolate. Capitula are numerous and terminal to leafy flower stems, with a diameter ranging from 1.0 to 1.5 cm. Phyllaries are numerous, lanceolate to ovate (the inner ones elongated), with dark streaks underneath, ciliate on margin, cuticular at the top, almost toothed. The corolla is pink (brownish when dry) with a length of about 17 mm and composed of a narrow tube of 9 mm and a widened bell-shaped part of 8–10 mm with linear lobes of 5 mm. Stamen filaments are as long as the corolla while the pistil is higher than the corolla, with a bipinnate short stigma. Achenes are oblong, with a length of about 5 mm, almost flattened with a hairy reddish pappus, drooping, slightly longer than the achene (Borisova 1963; Davis and Kupicha 1975; Bussmann et al. 2020).

The natural habitats of *K. quinquefolia* are deciduous forests or open areas at 300–2,200 m above sea level in: a) *Carpinus orientalis* Mill. forests (Georgian Colchis) as a diagnostic species of the association *Campanulo*





**Figure 2.** Detailed pictures of *K. quinquefolia* (M.Bieb. ex Willd.) Greuter & Wagenitz (Asteraceae). (a) Flowering head; (b) leaf; (c) fruiting head; (d) habitus. Pictures: Sara Borghesan.

*alliarifoliae-Carpinetum orientalis* Novák, Stupar & Kalníková, 2021 (Novák et al. 2021); b) *Zelkova carpinifolia* (Pall.) K.Koch forests (Georgia) as frequent species in the vegetation type *Zelkova carpinifolia-Carpinus betulus* (Novák et al.

2020); c) beech forest (*Fagus orientalis* Lipsky) of northern Iran in the Hyrcanian ecosystem (Bakhshandeh Navroud et al. 2017; Ghorbanalizadeh and Akhiani 2022); d) open areas along road sides (Karaköse 2021).

Flowering occurs between June and October while fruiting time is in November. In this species, the presence of the pappus facilitates anemochorous seed dispersal. The species is insect pollinated, especially by bumblebees (Pestov et al. 2017). The chromosome number is  $2n = 30$  (same number across the *Klasea* genus) while chromosome size ranges from 1.18 to 2.93  $\mu\text{m}$  (Martin et al. 2015).

The species is Euro-Siberian (Euxine province) and reaches the Iranian-Turanian region (Armenian-Iranian province). It is native to the Russian Caucasus, Armenia, Azerbaijan, Georgia, Iran, and Asian Turkey (Borisova 1963; Davis and Kupicha 1975; Tachtadžjana 1995; Gagnidze 2005; Martins 2005, 2006; Greuter and Raab-Straube 2008; Nowak et al. 2009). It is recorded as an alien species in Austria (Fischer et al. 2008).

The plant produces a good amount of biomass and can be easily cultivated. Young shoots are peeled and eaten; the leaves are used for preparing herb pies (*phkhali*), and both leaves and shoots are picked (Bussmann et al. 2020). From the juice extracted from the plants several phytoecdysteroids (e.g.,  $\beta$ -D-arbutin and hydroquinone) used in medicine have been isolated (Nowak et al. 2009; Odinokov et al. 2013). Its use for treatment of hyperpigmentation is reported (Urbanska et al. 2014).

Further four taxa of *Klasea* are reported for the Italian native flora: *K. flavescens* (L.) Holub (with the subspecies *K. flavescens* subsp. *cichoracea* (L.) Greuter & Wagenitz and *K. flavescens* subsp. *mucronata* (Desf.) Cantó & Rivas Mart.), *K. lycopifolia* (Vill.) Á.Löve & D.Löve, *K. nudicaulis* (L.) Fourr., and *K. radiata* (Waldst. & Kit.) Á.Löve & D.Löve subsp. *radiata* (Portal to the flora of Italy 2024; <https://dryades.units.it/floritaly/>). All these species have a South European and/or Pontic range and different morphological characters in comparison to *K. quinquefolia* (Pignatti et al. 2018).

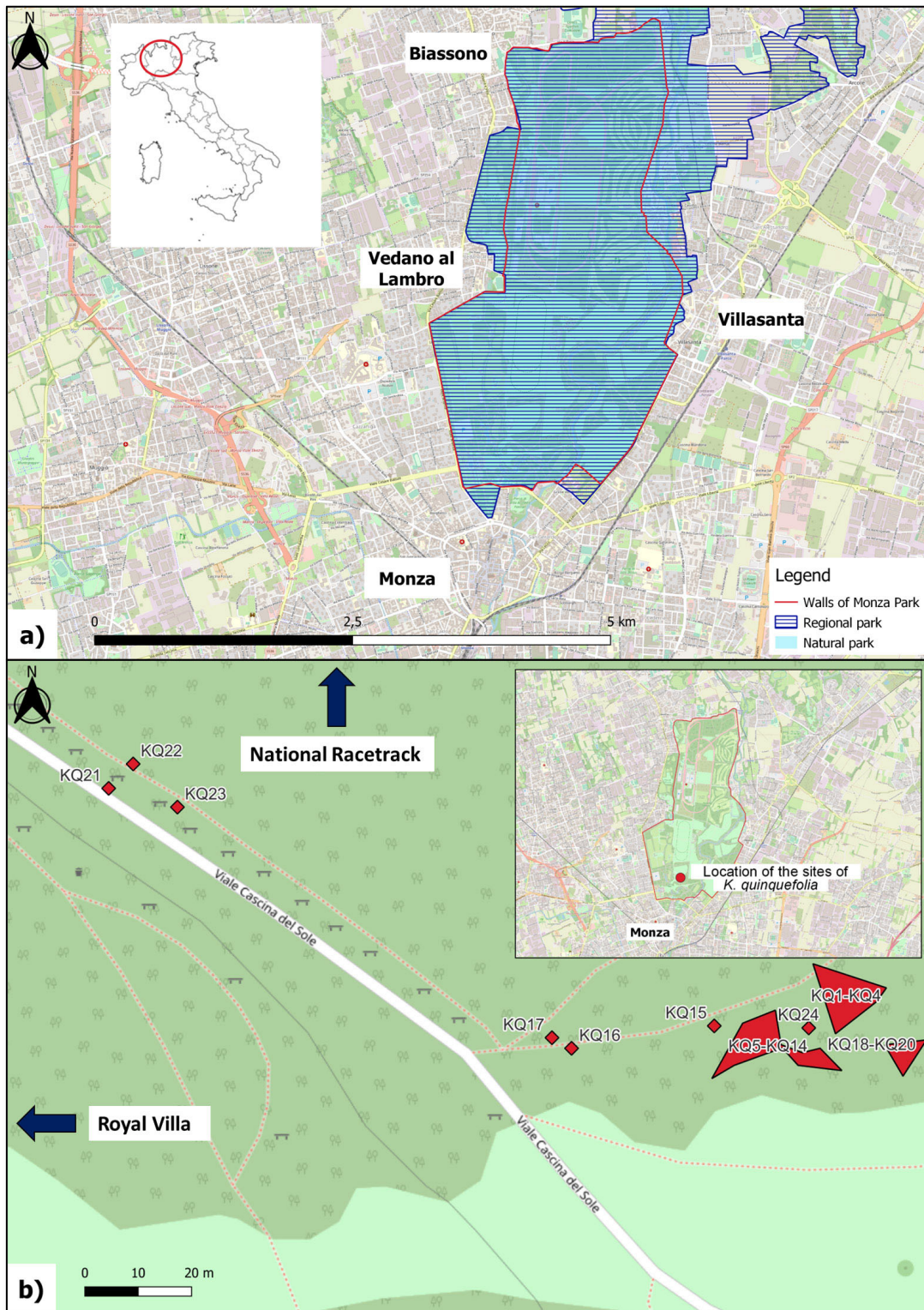
In this work, we reported the first occurrence of the alien *K. quinquefolia* in Italy providing relevant information on its morphology, distribution, ecology, and biology and as a baseline for its future monitoring and control.

## Materials and methods

### Study area

The investigation was carried out in a riparian forest along the Lambro River in the Monza Park, the largest walled park in Europe that was established on September 14, 1805 by Eugène de Beauharnais, Napoleon's stepson and viceroy of the Kingdom of Italy. The Monza Park has an area of 720 hectares (including the Royal Gardens of the Monza Palace), and it is located north of the city, across the municipalities of Monza, Villasanta, Veduggio al Lambro and Biassono of the Monza and Brianza province (Lombardy)





**Figure 3.** (a) Location of the Monza Park (Lombardy, Italy); (b) Location of the sites of *K. quinquefolia* within the Monza Park (Lombardy, Italy). “KQ” stands for *K. quinquefolia*.

(Figure 3). With the Royal Gardens, the Monza Park constitutes a complex landscape patchwork, with historical and architectural value. Also it is included in the Lambro Valley Natural Park (L.R.Lombardy n. 18, December 9, 2005) and Lambro Valley Regional Park (L.R. n. 82, September 16, 1983) (Figure 3). The species only occurs within the municipality of Monza.

Within the park there are several ancient architectonic structures (villas, farmsteads, mills), bicycle paths, an equestrian centre (founded in 1923), the famous Formula 1 National Racetrack (founded in 1922), and the Milano Golf Club (founded in 1928). The park is also rich in flora and fauna typical of the Po valley woodlands (Cuconati and Erba 1995; Rovelli 2006; Ferrari and Zaffaroni 2008). The soil in the area mainly consists of Fluvic Endoskeletal Calcaric Cambisols rich in rock fragments in depth and exhibit subalkaline to neutral reaction (ERSAL 1999). The average annual precipitation and temperature are 1,044 mm and 12.7 °C, respectively (1982–2012; <https://it.climate-data.org/>).

Along both banks of the Lambro River, we investigated 10 riparian sites dominated by *Carpinus betulus* L., *Quercus robur* L. subsp. *robur* and *Ulmus minor* Mill. subsp. *minor*. The nomenclature of the plant species mentioned in this work follows the checklist of the vascular flora native (Bartolucci et al. 2024) and alien to Italy (Galasso et al. 2024; Portal to the flora of Italy 2024; <https://dryades.units.it/floritaly/>). The potential vegetation can be referred to *Carpinion betuli* woodlands (Gentili et al. 2022).

*Sampling.* During the period of August–October 2023 we performed the field inspections in the Monza Park and verified the occurrence of the species after the personal communication of Crippa A. who first discovered it during a field trip in the Monza Park and indicated the point of the new occurrence through a forum on Italian flora, Acta Plantarum (<https://www.actaplantarum.org/>). We then extended the search to the nearest areas. In this way, we recorded several stands of *K. quinquefolia*, but only in the zones near the main population discovered by Crippa A. We collected GPS points and built a GIS database to create a presence-map of the species and calculate the size of the recorded stands.

For each population, we counted the population size, the number of flowering individuals (including the ones with fruits), as well as the number of sub-adult and juvenile individuals. Also, we described the vegetation of the area and characterised the soil-type at 30 cm depth.

*Herbarium samples.* The *K. quinquefolia* samples were deposited at the Herbarium Centrale Italicum of the Natural History Museum, Firenze (FI), at the Museo di Storia Naturale di Milano Herbarium, Milano (MSNM), and at the Herbarium Regium Modoetiense, Monza (Italy). The acronyms of the herbaria follow the Index Herbariorum (2023; <https://sweetgum.nybg.org/science/ih/>).

The criteria proposed by Pyšek et al. (2004) to define the invasion status of an alien taxon has been followed.

## Results

The species subject of this investigation was first recorded in Italy in the August 2023 at the Monza Park, Monza (Monza and Brianza province), Lombardy (Figure 3). The record was then inserted in the online data repository

**Table 1.** Population codes, surface area (m<sup>2</sup>), population size (n° of flowering individuals), n° of sub-adults and juveniles of the occurrence of *K. quinquefolia* in the study site. “KQ” stands for *K. quinquefolia*.

Code of population	Surface area (m <sup>2</sup> )	Population size (flowering)	N° of sub-adults and juveniles
KQ1–KQ4	85,111.000	120–140	30–40
KQ5–KQ14	95,008.000	90–100	45–55
KQ15	1,419.000	7	3
KQ16	1,014.000	7	6
KQ17	1,193.000	7	0
KQ18–KQ20	24,324.000	80–90	15–20
KQ21	0.200	2	0
KQ22	0.085	6	0
KQ23	0.383	6	0
KQ24	0.150	3	0
TOTAL	208,069.818	328–368	99–124

“Global Biodiversity Information Facility” (GBIF; <https://www.gbif.org>). The morphological measures of the individuals of *K. quinquefolia* found and analysed are consistent with those is reported in the literature.

#### *Population structure and size*

The population was subdivided in 10 local subpopulations distributed in habitat patches with surface areas ranging from about 0.085 to 95,008 m<sup>2</sup> (Table 1). The total population accounted almost 500 individuals with a flowering population size of about 350 individuals.

*Habitat.* The new Italian population of *K. quinquefolia* was found in a mesophilous woodland in a city park area (Monza Park, Lombardy) dominated by *Carpinus betulus* L. (Figures 3b, 4).

The stand of the occurrence was characterized by *Acer platanoides* L. and *Celtis australis* L. subsp. *australis* with the presence of *Pinus wallichiana* A.B.Jacks. and *Diospyros lotus* L. In the herb layer the following species were recorded: *Agrimonia eupatoria* L. subsp. *eupatoria*, *Alliaria petiolata* (M.Bieb.) Cavara & Grande, *Brachypodium sylvaticum* (Huds.) P.Beauv. subsp. *sylvaticum*, *Chaerophyllum temulum* L., *Geranium robertianum* L., *Hedera helix* L. subsp. *helix*, *Oplismenus undulatifolius* (Ard.) P.Beauv., *Phytolacca americana* L., *Rubus* sp., and *Vinca minor* L.

The soil, not structured, exhibited the following characters: litter thickness = 0.5 cm; layer 0.6–15.0 cm = sand > 70%, with scarce silt and clay and the presence of soil skeleton made of pebbles of 3–4 cm.

#### *Specimens label*

ITALY. Monza (Monza e Brianza), Parco di Monza, ca. 120 m NW Laghetto della Valle dei Sospiri (WGS84: 45.59482°N, 9.28035°E), margine boschivo, 155 m, no exp., 22 August 2023, leg. S. Borghesan & F. Fasano, det. A. Crippa, conf. E. Banfi & G. Galasso (FI, MSNM barcodes MSNM53080, MSNM53081, *Herb. Regium Modoetiense*).

The information of herbarium samples is reported in Table 2.





**Figure 4.** Panoramic photo of the station KQ1–KQ4. Picture: Federica Fasano.

**Table 2.** Date, site, Lat./long., altitude, habitat, Leg., Det., note of Herbarium sample. “Lat./long.” represented the average GPS coordinates of *K. quinquefolia* sites (in decimal degrees).

Date	22/08/2023	Habitat	Forest edge
Site	Monza Park	Leg.	Sara Borghesan & Federica Fasano
Lat./long.	45,59482/9,28035	Det.	Augusto Crippa
Altitude	155 m s.l.m.	Note	Along the pathway

## Discussion

Considering the natural distribution of *K. quinquefolia* in eastern Europe and western Asia, our work reports for the first time the species in Italy as a naturalized alien plant according to the criteria of Pyšek et al. (2004). This is also the second occurrence recorded for Europe outside the native range after those reported for Austria (Fischer et al. 2008). The new record is confirmed by the absence of the species from the Italian inventory of alien species (Galasso et al. 2018, 2024; Portal to the flora of Italy 2024; <https://dryades.units.it/floritaly/>).

Currently, despite the limited distribution of the new occurrence, considering that the species was found in a riparian forest, it has the potential for further spread along forest patches and clearings along the valley of the Lambro River (a main tributary of the Po River). The establishment and the further spreading of the species in the study area could be linked to the life form (haemicryptophyte with short rhizomes), the dispersal method of the seeds (achene with pappus), and to the occasional river flooding of the Lambro river.

In its native range, the species is commonly found in deciduous temperate forests, along with species with European-Caucasian distribution such as



*Acer campestre* L., *Carpinus betulus*, and *Fraxinus excelsior* L. subsp. *excelsior* (Novák et al. 2021). These wood species are widespread in the Monza Park and across the Po Valley suggesting a suitability of the temperate forests of the Po Valley (mixed deciduous woodland dominated by *Carpinus betulus* and *Quercus robur*) to be invaded by *K. quinquefolia*. The species appears to have a broad ecological spectrum, being able to grow in different forest habitats, in ruderal stands, in open areas (roadsides) and in different altitudinal ranges (Karaköse 2021). Moreover, considering that the species produces a large number of fruits with pappus and can vegetatively reproduce via rhizome, forming scattered clusters of ramets, we argue that its potential for a further spreading in the invasion range is high. In fact, it is well known that the Asteraceae family includes several invasive alien species around the world (e.g., Sutherland 2004; Hao et al. 2011).

Considering that, outside its native range, the species has also been found in Austria at the Schönbrunn palace of Vienna (Beck von Mannagetta 1893; Adler and Mrkvicka 2003), it can be hypothesized that the spread of the species in Italy may have occurred in historical times (XVIII and XIX centuries) for the presence of Habsburg family in Monza and in the palace adjacent to the Monza park. In fact, it was already reported as cultivated in the Imperial Botanical Garden of the Monza palace in 1813/14 (Anonymous 1813, 1814) and in 1825 (Rossi 1826).

In light of these considerations, ongoing and future investigations will explore the potential presence of the species in the region (Lombardy, N-Italy). Continuous monitoring and field research are essential to document alien species, providing insights into the invasion potential of *K. quinquefolia*. This is crucial for early detection and the development of possible eradication strategies (Maxwell et al. 2009), although we still have no evidence of impacts to native habitat and flora.

The establishment of the species in the Monza Park is probably linked to the presence of internationally frequented facilities that might have favoured the unintentional arrival of propagules of *K. quinquefolia*, including: (a) the Royal Palace of Monza, home of the Savoy dynasty; (b) the Monza Racetrack, home of the international Formula 1 Grand Prix; (c) the Golf Club Milano. Indeed, the species is not listed among the ornamental plants, to the best of our knowledge.

In conclusion, our study presents for the first time a comprehensive description of the species *K. quinquefolia*, newly identified as an alien species in Italy and until now scarcely considered in the literature. We suggest the periodical monitoring of the population newly recorded in the Monza Park in Italy to assess potential impacts to the native flora and habitats. Given the very restricted range of the established population, a prompt manual eradication (avoiding rhizome fragment dispersal) could be a possible solution to avoid its further spreading in Italy.

## Authors' contribution

Research conceptualization: GG and RG; sample design and methodology: EB, GG, RG; investigation and data collection: AC, SB, FF, LQ; data analysis and interpretation: SB, FF; ethics approval: all authors; funding provision: RG, SC; roles/writing – original draft: SB, FF, RG, GG; writing – review and editing: all authors.

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